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(54) Side-bar chain for conical pulley transmissions

(57) A side-bar chain (1,2) for continuously variable conical pulley transmissions with joint pieces in the form of thrust members pushed into apertures of the side-bars (5) and connecting the individual chain links formed by side-bar packs is described. The end faces of the thrust members (14, 16) serve for frictional force transmission between friction pulleys (8, 9) and the side-bar chain. The construction is such that, over the chain length, the lengths of the thrust members (14, 16) of individual joints, taken transversely of the running direction of the side-bar chain, are not all the same. Preferably the chain comprises thrust members of two different lengths.

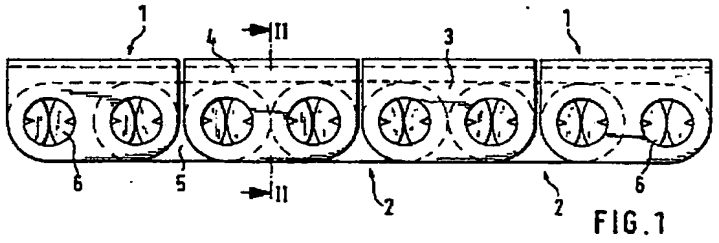

FIG.1

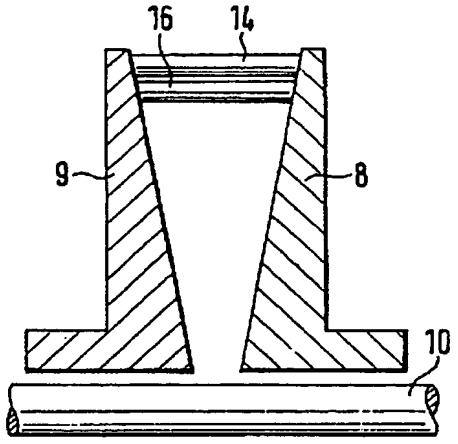

FIG.3

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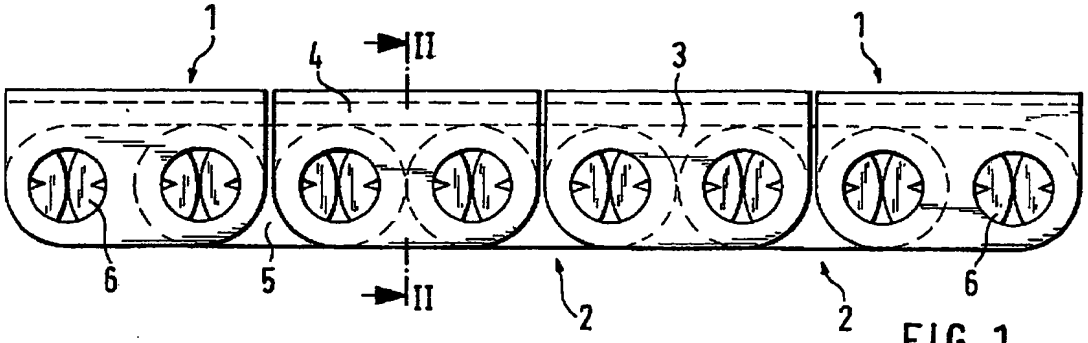

FIG.1

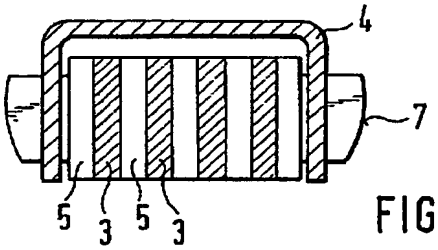

FIG.2

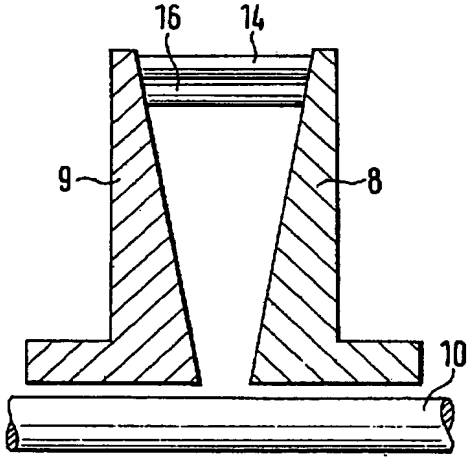

FIG.3

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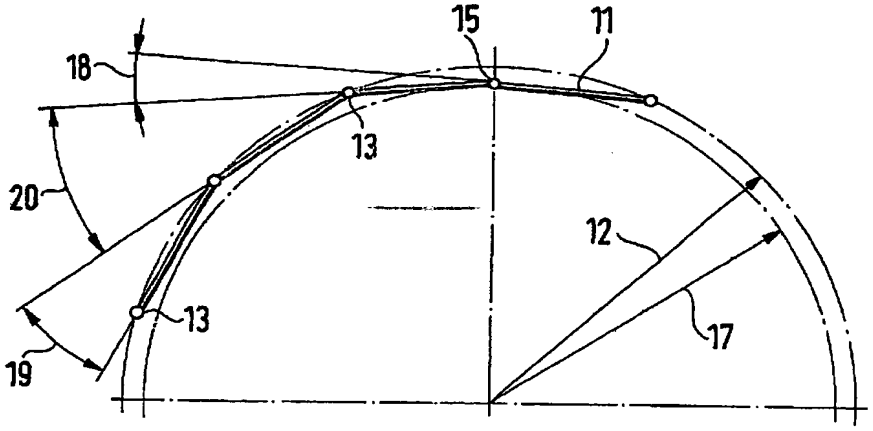

FIG. 4

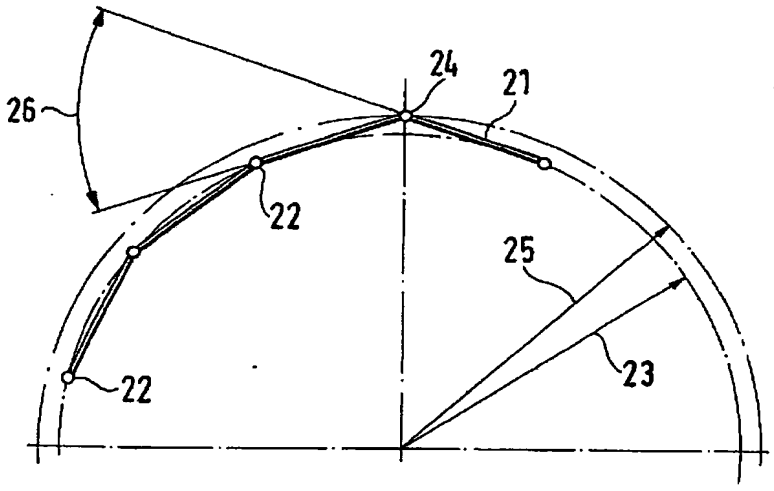

FIG. 5

SPECIFICATION

Side-bar chain for conical pulley transmissions

The invention relates to a side-bar chain for continuously variable conical pulley transmissions, of which the joint pieces connecting the individual chain links formed by side-bar packs are formed as thrust members pushed into apertures of the side-bars and having end faces serving for force transmission between friction pulleys and the side-bar chain.

Such chains possess a plurality of forms of configuration as regards the joint pieces, in which connection reference is made merely by way of an example to German Patent Specifications Nos. 1 302 795 and 2 356 289 and to British Patent Specifications Nos. 2 035 508, 2 080 477 and 2 102 530. The joint pieces can be cylindrical joint bolts, pairs of rocker pieces, single rocker pieces forming the entire joint piece or the like. In this respect, there is no restriction in the object of the present invention.

In all side-bar chains of the kind under discussion, on entry of the chain into the V-groove of the respective friction pulley pair impacts occur between the thrust pieces and the friction pulleys, that is to say, undesired generation of sound in solid matter. These noises are especially unpleasant when the periodic impacts enter the range of resonance vibrations of the transmission parts, as for example friction pulleys and housing walls, and they are felt subjectively to be especially burdensome as a characteristic individual note, possibley together with its harmonics.

This noise problem has been countered in one way by a maximum possible reduction of the chain pitch and thus a reduction of the mutual distance between adjacent joint pieces, in order to increase the frequency of pulses and to reduce their intensity. Another way which has been taken consisted in countering the regularity of the single note production by an irregular chain pitch, with the aid of which it was possible also to prevent the build-up of vibrations.

Even though good results were achieved with these measures, there is still room for further improvements of the noise behaviour because the measures as described sometimes could not be fully exploited for other reasons, for example a chain length predetermined for design reasons.

It is therefore the task of the invention to modify and/or further develop a side-bar chain of the initially stated kind in such a way that an improvement of the noise behaviour and a further avoidance of resonance vibrations and single notes result, while the measures to be taken should be favourable as regards cost, that is to say, they should not appreciably influence the chain in its actual construction and its manner of function as well as with regard to the purchase costs.

In a side-bar chain of the initially stated kind this task is solved in accordance with the invention in that in a sequence which is aperiodic over the chain length the lengths of the thrust members of individual joints, taken transversely of the running direction of the side-bar chain, vary.

This measure has the effect that in the looping arc between the friction pulleys, the thrust members travel differently as regards the radial direction into the groove of the pulley, resulting also in different tilt angles between adjacent chain links, which takes effect upon the size of the normal force exerted by the friction pulleys upon the thrust members and thus finally upon the acoustic energy generated in the occurrence of the normal force. In this connection the invention is based upon recognition of the fact that the normal force is approximately directly proportional to the angle of tilt between adjacent chain links, that is to say varies with this angle of tilt.

Due to the aperiodic distribution of the thrust members of different lengths a disturbance is generated in the regularity of the sound generation and thus an elimination of single notes is achieved.

It has proved expedient for the chain to comprise thrust members of two different lengths. This has proved to be adequate and moreover simplifies the production and storage of several different thrust members.

The variation of length of a portion of the thrust members in comparision with the "standard" thrust members can in principle be effected both in the positive and in the negative direction. However, it has proved advantageous that the length of about 5 to 30% of the thrust members of a chain is less than that of the other thrust members.

The difference of the thrust member lengths is dimensioned so that in the running of the side-bar chain a frictional force-transmitting contact takes place between friction pulleys and all the thrust members. In order to give an idea here of the occurring orders of size it can be pointed out that with a V-groove angle of 20° and a chain width or thrust member length in the region of about 25 mm, the difference of length lies in the range of about 0.2 mm.

Furthermore, in individual cases it may also be expedient if the length of individual thrust members is dimensioned so that no contact takes place between them and the friction pulleys. This measure, intended only for some few thrust members, is logical for a greater disturbance of the occurrence of single notes.

The object of the invention is applicable to all side-bar chains of the kind under discussion, that is, equally to side-bar chains with unequal chain pitch, and also leads additively to the initially mentioned precautions for a fur-

ther improvement of the noise behaviour.

Further features and details of the invention appear from the following explanation of embodiment by reference to the drawings, wherein:

Figures 1 and 2 show a side-bar chain, once in lateral elevation and once in section II-II according to Figure 1;

Figure 3 shows the pairing of friction pulleys and thrust members in a simplified partial axial section through a set of pulleys;

Figure 4 shows the simplified representation of the ooping arc with thrust members some of which are reduced in length, and

Figure 5 shows the simplified representation of the looping arc in the case of thrust members some of which are increased in length.

Figures 1 and 2 show a side-bar chain with chain links 1 and chain links 2 arranged therebetween. The chain links 1 are composed of side-bars 3 and bracket side-bars 4 bent into U-shape, while the links 2 are composed of side-bars 5. The individual links 1 and 2 are articulatedly connected with one another at their articulation points by thrust pieces in the form of rocker piece pairs 6, which are situated in shape-locking engagement against twisting with adjacent links and roll against one another on their rocker faces directed towards one another. The rocker pieces of the rocker piece pairs 6 have end faces 7 by way of which they come into frictional contact with the friction pulleys of a conical pulley transmission.

In the side-bar chain, which is known thus far and is explained once more for the sake of completeness as an example representing the numerous other forms of construction of known side-bar chains for conical pulley transmissions, the thrust pieces formed here as rocker pieces 6 have exactly equal lengths with one another. At this point now the modification leading to the new form of construction comes into effect, according to which the lengths of the thrust pieces are made to vary relative to one another, which has the effect explained in greater detail by reference to Figures 3 and 4.

Figure 3 shows the upper half-section of two friction pulleys 8, 9 which are arranged on a transmission shaft 10. Between the friction pulleys (see also Figure 4) a side-bar chain, the links 11 of which are reproduced in a stylised manner, runs around on the "normal" looping arc with radius 12, along which it is in abutment with the thrust members of its articulation points 13 on the friction pulleys 8, 9. These thrust members bear the reference 14 in Figure 3.

Individual articulation points, e.g. in Figure 4 the articulation point 15, are equipped with shorter thrust members 16 which are consequently subjected to tensile stress acting upon the side-bar chain to draw them more strongly into the pulley groove between the friction pulleys 8, 9 and thus assume the running radius 17 according to Figure 4. In a directly proportional manner this has the consequence that the side-bars adjoining an articulation point 15 with shorter thrust members 16 have a smaller tilt angle 18 than is the case for the tilt angle 19 of the chain links the articulation points of which are formed by "standard" thrust members. The angle of tilt 20 in the transition from a chain link 11 with a shorter joint member 15 to a chain link with two "standard" joint members is still greater than the tilt angles 18 and 19.

In contrast to Figure 4, Figure 5 shows the looping arc of a side-bar chain with chain links 21 the "standard" articulation points 22 of which move along a running circle with radius 23, while an articulation point 24 has a comparatively longer joint member which consequently cannot penetrate so deeply into the pulley nip as the joint member of the articulation points 22, and which thus moves on a running circle with a larger radius 25. Here, in reversal of the conditions explained in detail by reference to Figure 4, the chain links 21 adjoining the articulation point 24 form the largest tilt angle 26.

Of course, mixed forms of the possible embodiments explained by reference to Figures 4 and 5 are conceivable. It can also be provided for a few individual articulation points of a side-bar chain that the joint members are so short that they do not come into bearing contact with the friction pulleys 8, 9. This possibility is not represented in the drawings. Compared with the illustration in Figures 4 and 5, however, the result would be that the chain links connected with one another by such an articulation point would give rise to a common straight line.

The forms of chain construction described by reference to Figures 3 to 5 have the effect that, unlike the remainder of the chain, the joint members of reduced or increased length effect a reduction of the noise generation caused by the chain and disturb or prevent the occurrence of resonance vibrations and the production of single notes.

CLAIMS

1. Side-bar chain for continuously variable conical pulley transmissions, comprising joint pieces connecting individual chain links which are formed by side-bar packs, the joint pieces being constituted by thrust members pushed into apertures formed in the side-bars, the end faces of said thrust members serving for frictional force transmission between friction pulleys and the side-bar chain, and wherein, in a sequence which is aperiodic over the chain length, the lengths of the thrust members of individual joints, measured transversely of the running direction of the side-bar chain, are unequal.

2. Side-bar chain according to claim 1,

wherein the chain comprises thrust members of two different lengths.

3. Side-bar chain according to claim 2, wherein the length of substantially 5% to 30% of thrust members is smaller than that of the other thrust members.

4. Side-bar chain according to any preceding claim wherein the difference of the thrust member lengths is dimensioned so that in the circulation of the side-bar chain a frictional forcetransmitting contact takes place between friction pulleys and all the thrust members.

5. Side-bar chain according to claim 1, wherein the length of individual thrust members is dimensioned so that no contact takes place between them and the friction pulleys.

6. Side-bar chain according to claim 1 substantially as herein described with reference to and as shown in any of the embodiments illustrated in the accompanying drawings.

7. A continuously variable transmission including a side-bar chain according to any preceding claim.

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